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DEPARTMENT OF INTERNAL AFFAIRS
James F. Woodward, Secretary

BUREAU OF TOPOGRAPHIC AND GEOLOGICAL SURVEY
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COAL BEDS IN ARMSTRONG COUNTY, PENNSYLVANIA

By

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Introduction.

Armstrong County ranks ninth in Pennsylvania as a producer of bituminous coal. In 1918 the total output was 6,051,753 tons, valued at \$17,948,429; 5,674,245 tons, valued at \$16,959,624, were loaded at the mines for shipment. The quantity sold to local trade and used by employees was 118,937 tons, valued at \$274,010; 258,571 tons were used at the mines for steam and heat, valued at \$714,795.

After the high volatile coals of the Irwin basin have been exhausted, Armstrong County will become one of the foremost producers of bituminous coal in Pennsylvania. It contains larger reserves of easily accessible high volatile coal than any other county in the State. These coals are very high in sulphur, but when washed they make excellent gas coal. Large areas of coal are unmined and even untested by outcrop prospects or core drill. The coals are regular in thickness, uniform in quality, and can be easily mined by drift or slope at most every point.

There are about twenty coal beds in Armstrong County, two of which, the Upper Freeport and the Lower Kittanning, have great value in large areas. The Upper Kittanning, Lower Freeport and Pittsburgh beds are mineable in more restricted areas. Several other beds are locally mineable; the remainder have no economic importance at present and only prospective future value.

Armstrong County lies northeast of Pittsburgh on Allegheny River. It is bounded on the north by Clarion County, on the east by Jefferson and Indiana counties, on the south by Westmoreland County, and on the west by Butler County. Its greatest width is 25 miles near the

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TO THE SECRETARY, DEPARTMENT OF AGRICULTURE

FROM THE SECRETARY, DEPARTMENT OF AGRICULTURE

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northern edge, and its greatest length is $34\frac{1}{2}$ miles on the western boundary. Its area is about 633 square miles, and its population in 1920 was 75,568.

Coal transportation is almost entirely by railroad. The Allegheny River Division of the Pennsylvania Railroad follows the east bank of Allegheny River across the county. A branch of this railroad leaving the main line at Red Bank follows Redbank Creek on its Clarion County side, and serves mines along the north boundary of Armstrong County. A short branch in the southwestern corner of the county serves the Big Buffalo Creek area. The Pittsburgh and Shawmut Railroad follows the west bank of the Allegheny as far north as Mahoning Creek; it crosses the river there, and follows Mahoning Creek into Jefferson County. The Baltimore and Ohio, and the Allegheny River Railroads have a few miles of track in the northwestern tip of the county. The Buffalo, Rochester and Pittsburgh Railroad crosses the county from Craigsville to Dayton.

The highways are practically all dirt, the main travelled ones being kept in very good condition. In the unsettled parts of the county the roads are bad even in summer. The improved roads are confined almost entirely to the valley of Allegheny River, and are the only ones used for coal transportation.

The surface of Armstrong County is decidedly hilly. The valleys are narrow, with precipitous sides, and narrow flood plains. Large areas of flat or gently sloping land form the more elevated parts of the surface and are remnants of old peneplains. Allegheny River valley is for the most part narrow, with steep slopes, and very narrow flood plains.

STRUCTURE.

There are eleven major structural features in the county, each having a general northeast-southwest trend. They are as follows, in order from southeast to northwest: Elders Ridge syncline, Dutch Run anticline, Roaring Run anticline, Apollo syncline, Greendale anticline, Brookville anticline, Fairmont syncline, McHaddon syncline, Boggsville syncline, Kellersburg anticline, Bradys Bend syncline.

The western flank of the Elders Ridge syncline lies on the southeastern county boundary. This deep basin brings the Pittsburgh coal to outcrop on the Armstrong-Indiana county line. The rocks rise regularly and rapidly northwest.

Roaring Run anticline enters the county between Apollo and Avonmore, and extends northeast to Yatesboro, where it flattens out and disappears. It is a broad, flat anticline, with gentle slopes. The axis varies in elevation, and is double for about four miles where it crosses Crooked Creek near Girty.

Dutch Run anticline is a small fold with gently sloping flanks, lying just east of Dutch Run near the southeastern county line. It may be considered a spur of the Roaring Run anticline.

Apollo syncline lies northwest of Roaring Run anticline and extends through Cochran Mills to a point one mile south of Yatesboro. It is a narrow, shallow basin, with its axis dipping northeast to its lowest point on North Branch; from there it rises again until it merges with Roaring Run anticline south of Yatesboro.

Greendale anticline, lying northwest of Roaring Run anticline, extends between Crooked Creek and Mahoning Creek, and passes through Greendale. Its axis is irregular in elevation and direction. The rocks dip regularly on both flanks, the greatest dips being just north of Buffalo Creek.

The southern tip of Brookville anticline extends southwest to Mahoning Creek in the northeastern part of the county. Its axis plunges regularly to a point near Putneyville, where it merges with Fairmont syncline.

Fairmont syncline, lying northwest of Greendale anticline, is a broad basin, the axis of which dips to the southwest. The rocks rise rapidly on both flanks.

McHaddon anticline is a small fold running parallel to Allegheny River just west of Ford City and Kittanning. Its axis is nearly level, and the rocks dip gently on both flanks.

Boggsville syncline, lying northwest of McHaddon anticline, extends from Big Buffalo Creek to a point northwest of Kittanning near Allegheny River. It is a broad basin with the axis dipping southwest. The rocks rise rapidly northwest to the Kellersburg anticline.

Kellersburg anticline is the most pronounced fold in the county. It enters the county from the west near Winfield and extends northeast near Craigsville, Mahoning and Kellersburg. The axis rises to a point midway between Browns Crossroads and Cowansville, where the rocks dip to the north, west, and south. The rocks begin to rise again at Allegheny River, and the deep channel of Redbank Creek exposes the Pocono sandstone.

Bradys Bend syncline enters the county two miles southwest of Somerville, and extends northeast to the Allegheny. It is a broad flat basin with extremely gentle dips on its flanks.

STRATIGRAPHY.

The outcropping rocks of Armstrong County belong to the Quaternary system, and to the Pennsylvanian and Mississippian series of the Carboniferous system. The Monongahela, Conemaugh, Allegheny and Pottsville formations alone are coal bearing.

The Quaternary system is composed of (1) recent deposits of alluvium in the valleys, (2) gravel and silt of glacial origin, (3) the Carmichaels formation composed of thin deposits of alluvium and

stream-worn material on the terraces along Allegheny River.

The Monongahela formation has been entirely eroded, except in the southeastern corner of the county, where the lower part is preserved in the hills along the county line. Two hundred and sixteen feet of strata remain above the Pittsburgh coal, chiefly limestones, sandy shales, sandstones and thin coal beds.

The Conemaugh formation is present in the southern two-thirds of the county except where streams have eroded it. The upper part of this formation has been eroded over large areas. The total thickness of the formation is about 650 feet, and it is composed largely of shales, a few limestones and several massive sandstones.

The Allegheny formation, composed of shales, massive sandstones, thin limestones, and several workable coal beds, remains almost intact.

The Pottsville formation is exposed on the Allegheny and its chief tributaries from Templeton to the northern county line. It is composed of two massive sandstones with shale between them. Its total thickness is about 140 feet.

COAL BEDS.

The following table shows the stratigraphic relation of the coal beds and their range in thickness.

Coal Beds in Armstrong County

Name of bed		Range in interval	Range in thickness of coal beds
Monongahela	(Sewickley - - - - -	80	6" - 2'0"
	(Redstone - - - - -	40	6' - 10'0"
	(Pittsburgh - - - - -	490	6" - 4'0"
	(Bakerstown - - - - -	70	0 - 2'6"
Conemaugh	(Brush Creek - - - - -	40	0 - 3'0"
	(Mahoning - - - - -	50	
	(Upper Freeport ("E") - - - - -	35-55	2' - 7'2"
	(Lower Freeport ("D") - - - - -	40-50	2' - 6'0"
Allegheny	(Upper Kittanning ("C' ") - - - - -	45-55	1' - 15'0"
	(Middle Kittanning ("C") - - - - -	40-70	1' - 3'0"
	(Lower Kittanning ("B") - - - - -	70-90	1' - 5'0"
	(Clarion ("A' ") - - - - -	20-30	0 - 3'5"
	(Craigsville - - - - -	20-35	0 - 3'6"
	(Brookville ("A") - - - - -		2' - 4'0"

The Lower Kittanning and Upper Freeport are the important coals of the county. The Upper Kittanning, Lower Freeport and Pittsburgh beds are mined locally. Several other beds are mined for local use, and many others average only a few inches thick.

Brookville ("A") coal. This bed lies about 20 feet above the Homewood sandstone, and outcrops only along Allegheny River and its tributaries. In general the bed is lenticular and extremely variable in quality; locally it is thick and the quality is good. The coal is hard, lustrous and splintery. It is mined at many country banks for local use and one shipping mine near Red Bank is thought to be on the Brookville bed. On Mahoning Creek the bed ranges from 2 to 4 feet thick, but the coal is in two benches, separated by a shale parting 2 to 8 inches thick. Outcrops of the bed on Crooked, Pine, and Cowanshannock creeks indicate that it is inferior in quality. At Buffalo Mills the bed is 3 feet 2 inches thick, but has several shale partings, and is valuable only as a source of local fuel. On Rough Run the coal is 2 feet 6 inches thick, including two 1 inch bone partings. It is reported to be 3 feet 2 inches thick in West Franklin township. The bed is deep under cover in most of the southern part of the county, but drillings indicate that it is too variable in thickness and quality to make mining of it profitable.

Craigsville coal. This bed, lying 20 to 35 feet above the Brookville, is a local occurrence and has a maximum thickness of 3 feet on Buffalo Creek, two miles northwest of Craigsville. It is reported to be 3 feet 6 inches thick half a mile northwest of Craigsville. It is a very good clean coal, but lenticular and subject to "roof rolls."

Clarion ("A") coal. This bed, lying about 75 feet above the Homewood sandstone, is thickest on the Allegheny north of Mahoning Creek. Here it ranges from 3 feet to 4 feet 8 inches thick, but is very pyritous and carries many bone and shale partings. At Barker City a 1 inch shale parting separates the bed into a 9 inch top bench and a lower bench 2 feet 8 inches thick. It is a hard compact coal, high in ash and sulphur. At the mouth of Mahoning Creek it ranges from 6 inches to 2 feet thick. At Buffalo Mills it is persistent and is 24 to 30 inches thick. The Clarion coal is worthless in the vicinity of Kittanning. On Rough Run it is 2 feet 6 inches thick, including two 1 inch shale partings. It is mineable at West Winfield and is 2 feet 6 inches thick at Fairmount. The coal is very thin or entirely lacking at all other localities.

Lower Kittanning ("B") coal. This bed, lying 120 to 140 feet above the Brookville coal is one of the chief sources of shipping coal in the county. It is the most important coal in the northern half of the county, especially west of a line drawn from Kellersburg to Kittanning. Within that area it is nearly everywhere over 2 feet 6 inches thick, averaging 3 feet 6 inches, and is locally 5 feet thick. Locally it has many bone partings and is high in sulphur. The bed probably is mineable in the whole area.

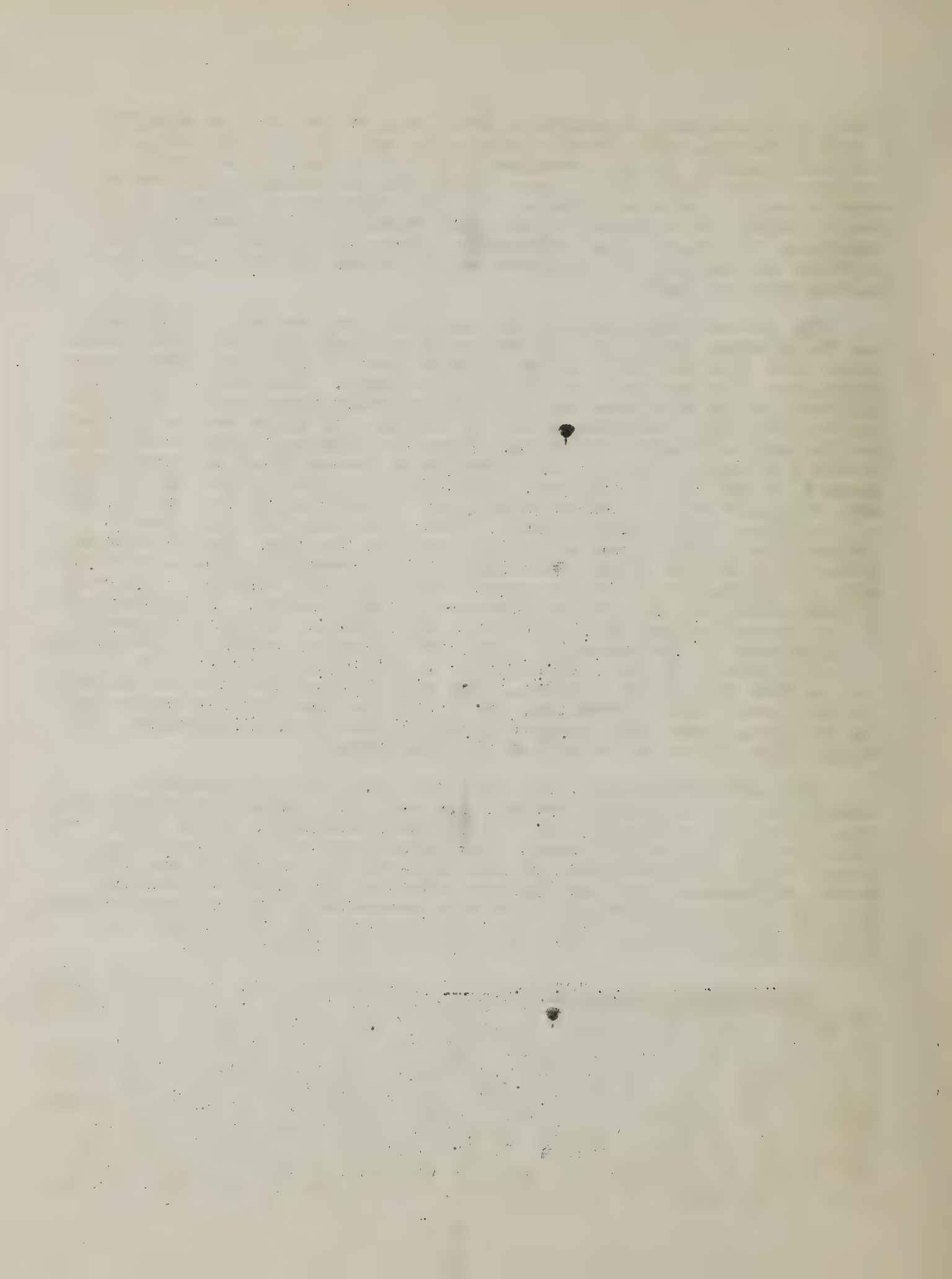
At Kittanning the bed is 3 feet 6 inches thick, has 3 to 4 inches of bony coal at the top, and carries small lenses of pyrite. At Cowanshannock it is 3 feet thick, not including 4 inches of bone coal at the top, and carries no partings; at Mosgrove 3 feet 11 inches

thick, not including 4 inches of bone coal at the top; at Rimerton 3 feet 6 inches, with the characteristic bone coal at the top. In Madison township the bed averages 3 feet 8 inches, with about 5 inches of bone coal at the top. There are no partings, but the coal carries small lenses of pyrite. The bed thins to an average of 2 feet 6 inches in Mahoning and Red Bank townships, although a local thickness of 4 feet is not uncommon. There are no characteristic partings or binders, but numerous small lenses of pyrite make the sulphur content high.

The average thickness of the coal in Wayne township is 3 feet and the maximum is 5 feet. Partings or binders are rare. The coal thins to 2 feet 6 inches in the eastern part of Pine and Boggs townships, but thickens westward to the Allegheny. The bed probably is thickest in the northern part of East Franklin township and in Washington township, averaging 3 feet 9 inches. It thins northward into Bradys Bend and Perry townships, where its average thickness is about 2 feet 6 inches. A bone coal averaging 4 inches thick is invariably present at the top of the bed. Opposite Red Bank the bed is divided into an upper bench 4 inches thick, and a lower one 3 feet thick, by a 1 inch bone and pyrite parting. Near Rimer the bed is 3 feet 2 inches thick, with 4 inches of bone coal at the top. Opposite Mosgrove it is 3 feet thick including a 1 inch parting 4 inches from the top; at Furnace Run 3 feet 3 inches with the same parting. The coal probably thins to the western boundary of the county. In Reyburn and Valley townships the coal averages 3 feet thick. It varies greatly in thickness in the townships along the Allegheny south of Kittanning, but will average 3 feet, including a 1 inch bone parting about 4 inches from the top of the bed. The coal is deep under cover in most of the southeastern townships, and little is known of its thickness and quality. Bore hole records indicate that it is lenticular, and ranges from 12 inches to 3 feet 8 inches thick.

The Lower Kittanning coal averages 37.5 per cent volatile matter, 50 per cent fixed carbon, 3.5 per cent sulphur and 8 per cent ash. The coal is bright, and has columnar cleavage. It is soft, but mines out in fair sized lumps. The percentage of slack is rather large. With the exhaustion of the high-volatile coals of the Irwin basin, in Westmoreland and Fayette counties, the Lower Kittanning coal of Armstrong County will be used extensively for gas manufacture. It will be necessary to pick and wash the coal to attain the excellent quality of the coals now mined in the Irwin basin.

Middle Kittanning ("C") coal. This bed lies 45 to 55 feet above the Lower Kittanning coal. It is persistent in the county, but rarely is thick enough to be mined profitably. The coal is clean and averages about 12 inches thick. One mile west of Cowansville it is 2 feet thick where exposed by stripping. The same thickness is indicated by its outcrops on Allegheny River, Mahoning and Red Bank creeks. Its blossom again shows in the vicinity of Sherrett, Morrows Corner and Adrian. One mile south of Mahoning Furnace the bed is about 2 feet 3 inches thick. In the southern and central parts of the county it averages less than 12 inches, but in the northeastern part of the county it is persistent, and locally is mineable. On the



North Fork of Pine Creek the coal is 2 feet thick where stripped, and a mile farther up the creek is 3 feet thick. The coal has been mined near Echo. On the South Fork of Pine Creek, two miles above Echo where the railroad crosses North Branch the Middle Kittanning coal is 2 feet 8 inches thick. Two miles further up the creek in an old opening it is 5 feet thick, but is very dirty and high in sulphur. The bed has the same character at Waltersenville.

Upper Kittanning ("C") coal. The Upper Kittanning coal, lying about 50 feet above the Middle Kittanning bed, is not a typical high volatile coal. Locally, especially in the northeastern part of the county, some of the bed is cannel coal. The coal occurs in long narrow troughs, evidently old stream channels. In these troughs the lower part of the bed, usually about 2 feet thick, is overlain by cannel coal, which is 5 to 13 feet thick in the axis of the trough, but thins to a feather edge on both sides. The average width of the mineable coal area is usually not over 600 to 800 feet. Unlike typical cannel, this coal, instead of having 45 per cent or more of volatile hydrocarbons, and a less amount of fixed carbon, has about $1\frac{1}{2}$ times more fixed carbon than volatile matter. It is also very high in ash.

The bed is mineable in the vicinity of Sherrett and Peach Hill, at Somerville, at Kaylor, and possibly also on Cove Run. At Somerville the coal and cannel shale is 13 feet thick in the center of a trough. The coal is thickest and best in Mahoning and Redbank townships, where it occurs in several apparently isolated deposits of unusual thickness. It consists of cannel coal and bituminous coal in two to four benches. On Cathcart Run, and in other localities between Putneyville and South Bethlehem, the bed is locally 15 feet thick and is composed of four benches, two of bituminous, and two of cannel coal. On the east side of Little Mudlick Creek, the Upper Kittanning coal has a maximum thickness of 13 feet 11 inches, 8 feet of which is cannel coal. In the Pine Creek region the coal has a persistent thickness of about 2 feet 9 inches. It was once mined on the South Fork of Pine Creek, near Pine Furnace, and is 2 feet 8 inches thick. Farther up Pine Creek, on the road to Goheenville, the coal measures 2 feet; at Echo, 2 feet 6 inches, and on Cowan-shannock Creek 12 inches to 3 feet. The Upper Kittanning coal is thin on Kiskiminitas River. It is 2 feet thick at Girty, and Cochran Mills on Crooked Creek. On Cherry and Carnahan's Run the bed has a maximum thickness of 3 feet, but averages much less.

The Upper Kittanning coal is used only for local fuel. Large operations have failed because the extreme irregularity of the bed makes mining unprofitable.

Lower Freeport ("D") coal. The Lower Freeport coal normally lies 35 to 55 feet above the Upper Kittanning coal. The interval is exceedingly variable on Allegheny River, and has led to an evident confusion of these two beds especially in the vicinity of Freeport. This problem must remain unsolved until more detailed work has been done in that area.

The Lower Freeport coal is extremely variable in thickness west of Allegheny River and is mined only for local use. At Cowansville and southward along Glade and Limestone Runs and along the Allegheny the bed is locally 3 feet thick. The coal is persistent east of Allegheny River. Where mineable it is 2 to 4 feet thick, and is a bright clean coal. In Madison, Mahoning and Redbank townships the coal has a local maximum thickness of 4 feet 6 inches. In several areas the coal averages 3 feet thick. Locally a 2 inch bony parting, high in sulphur, divides the bed into two benches. In Pine, Boggs, Wayne, Valley and Rayburn townships the coal has a local maximum thickness of 3 feet, but averages much less. It averages 2 feet thick in the southern part of the county and on the Kiskiminitas.

On Cowanshannock Creek the bed has fair thickness and the coal is clean. It is mined principally for local use. At Yatesboro the bed is 4 feet 6 inches thick, including a local 2 inch shale parting. On the South Fork of Pine Creek it is from 2 feet to 2 feet 6 inches thick. On the North Fork of Pine Creek, its average thickness is 21 inches, with a maximum of 2 feet 6 inches. It is thin on Mahoning Creek, but north of Putneyville it is nearly 4 feet thick, including ~~thin~~ thick bone partings near the roof and the bottom. The bed is 3 feet 10 inches thick on Redbank Creek. A 3 inch bony parting separates an upper bench 16 inches thick from a lower one 2 feet 3 inches thick. At South Bethlehem it ranges from 3 feet 6 inches to 6 feet, but the coal is locally extremely shaly, and carries much pyrite.

The Lower Freeport coal averages about 33.5 per cent volatile matter, 52 per cent fixed carbon, 8 per cent ash, and 2.5 per cent sulphur. It is a typical high volatile coal, and after the thicker and more persistent beds have been exhausted will have much value for gas manufacture.

Upper Freeport ("E") coal. This bed, lying between 35 and 55 feet above the Lower Freeport coal, is of great economic importance in the county. In the northwestern part of the county it ranks next to the Lower Kittanning, underlies large areas and has a maximum thickness of 4 feet. Although it is locally thin and dirty it averages over 3 feet thick. In the eastern and northeastern part of the county the Upper Freeport is the most important coal. It is very persistent, but in a few places is too thin to mine. In the southern part of the county it is known as the "four foot coal", although it will average only 3 feet 3 inches thick. A maximum thickness of 4 feet 6 inches is uncommon.

In the vicinity of Bradys Bend and Queenstown the Upper Freeport bed is divided into four benches by shale and bone partings that lessen its value. The bed averages 2 feet 9 inches thick, and is a bright, good coal. Locally it is more than 4 feet thick. At Karpis it is 5 feet thick; above the railroad tunnel on Long Run 4 feet 2 inches; half a mile east of Penelton 3 feet 9 inches; at Bradys Bend 4 feet 2 inches; at Leet, 4 feet thick, but very impure. It is 3 feet 9 inches thick at Sherrett. It is mined at Cowansville, where it averages 3 feet 3 inches thick. Locally two thin binders are present, otherwise the coal is clean. The coal is 3 feet thick at

Nichola, and 3 feet 4 inches thick at Worthington. The bed averages 3 feet thick in the townships west of the Allegheny, and south and west of Kittanning and is very regular. The coal is generally clean, but locally has two or three thin bone partings and pyrite lenses. Locally, 3 or 4 inches of the bottom coal is too dirty to be mined profitably.

The coal has been eroded in large areas in the northeastern townships. In the southern part of Madison township and in Pine township the coal is locally 5 feet 4 inches thick. It is lenticular, but will average 3 feet thick; a local band of pyrite, from 1 to 2 inches thick increases the sulphur content. The coal is very persistent and regular in thickness in Mahoning and Red Bank townships, ranging from 3 feet to 4 feet 4 inches, and averaging about 3 feet 4 inches thick. Locally there are one or two thin bone binders in addition to a 3 inch bone parting 8 inches from the bottom. In a few mines there are 4 to 6 inches of bone coal at the top of the bed. North of Deansville the Upper Freeport is 4 feet 4 inches thick, including 1 to 2 inches of bone coal at the top, and a thin parting 12 inches above the bottom; at Seminole, 3 feet 8 inches thick, including two 1 inch bone partings near the bottom; at South Bethlehem, 4 feet thick. It was once coked at Mahoning Furnace where it is 3 feet 11 inches thick. The coke was too tender for shipment. At McWilliams the bed is 4 feet 1 inch thick, not including 6 or 8 inches of bone coal at the top of the bed.

On Allegheny River in Boggs township the Upper Freeport coal averages 2 feet 8 inches thick and is free from partings and binders. Pyrite lenses are numerous in some places. The coal thickens eastward into Wayne township, averaging 3 feet 4 inches. Two miles east of Coheenville the coal is 3 feet 8 inches thick, with no partings, but high in sulphur. At McCrea Furnace it is 4 feet thick, including a thin parting near the middle of the bed. The coal is confined to isolated patches on the highest hilltops on the headwaters of Pine Creek. On a high knob one mile east of Muff, the coal is 4 feet 4 inches thick, separated into two benches by a 1 inch pyrite binder in the middle of the bed. The top coal is dirty. The coal is 3 feet 4 inches thick where mined at Dayton including a $\frac{1}{2}$ inch parting of bone coal and pyrite near the middle. The coal thickens to 4 feet 4 inches between Dayton and Echo, but is very dirty. At Echo the bed is 4 feet 2 inches thick, with a $\frac{1}{2}$ to 2 inch bone coal parting 4 to 10 inches from the bottom. The bed is also bony at the top.

In Cowanshannock township the bed is extremely variable in thickness. At Sagamore it measures 6 feet including a 6 inch bone parting near the middle, a 1 inch shale parting near the bottom, two pyrite bands and 5 inches of bony coal at the top of the bed. At Yatesboro the bed is 4 feet 2 inches thick, including 6 inches of bony coal at the top, and a $\frac{1}{2}$ to 2 inch bone parting 4 to 8 inches from the bottom.

In Rayburn and Valley townships the Upper Freeport averages 2 feet 8 inches thick, and carries no distinct impurities except local lenses of pyrite. On Garrett Run and in Kittanning and Manor townships the coal thickens locally to 6 feet 6 inches, including five thin partings.

The average thickness is less than 3 feet. One mile north of Heilman the coal is 3 feet 11 inches thick, with 9 inches of bone at the top. Half a mile east of McNees the bed is 3 feet 8 inches thick including several small clay partings. Half a mile east of Blanket Hill the coal thins to 2 feet under a heavy sandstone.

The Upper Freeport coal averages over 3 feet thick in Manor, Bethel, Gilpin and Parks townships. It ranges from 2 feet to 4 feet 6 inches thick, including local partings of bone and pyrite which are 6 inches thick in places. A few inches of bone coal at the top is very common.

In the southeastern townships the Upper Freeport coal has great importance. It ranges from 2 feet 6 inches to 5 feet thick in Kiskiminitas township and averages about 3 feet 9 inches. Small persistent bone partings lessen its value. At Apollo it is divided into two benches by a 1 to 2 inch bone parting. The upper bench is 2 feet 4 inches to 3 feet thick; the lower one 12 to 18 inches thick. The upper bench is good clean coal, but the lower one is dirty. The bed is persistently 4 feet thick on Roaring Run, and carries a small parting, usually not more than 1 inch thick. The bed is 7 feet 2 inches thick on Long Run, but has two partings, one 2 inches thick, and the other 18 inches.

The coal averages about 3 feet thick in South Bend, Burrell and Plumcreek townships, and is an important coal on Crooked and Plum Creeks. The bed is seldom free from partings of bone and sulphur. In some places the top of the bed is bony.

The Upper Freeport coal in Armstrong County is one of the largest reserves of high volatile coal in the State. Large areas have not been mined, and some are not as yet prospected. With improved methods of picking and washing the coal, Armstrong County will become the center of gas coal production in the State.

The composition of the Upper Freeport coal is as follows:

	Per cent
Range	Average
Volatile matter - - - - -	33-36 34
Fixed carbon - - - - -	52-57 54
Ash - - - - -	5-12 7
Sulphur - - - - -	1-4 2.1

The coal is soft, friable, brilliant in lustre, and breaks up when mined.

Mahoning Coal. The Mahoning coal lies about 50 feet above the Upper Freeport. It has a maximum thickness of 3 feet on Cherry Run. It is 18 inches thick on Crooked Creek, but has never been mined.

Brush Creek Coal. This bed, lying about 90 feet above the Upper Freeport coal, is persistent in the area west of Allegheny River where it averages about 15 inches thick. Near Worthington it

in some places the top of the bed is bony.

is 2 feet thick. On Crooked Creek the bed is locally 2 feet 6 inches thick, but very lenticular. It has a reported thickness of 2 feet 6 inches on the headwaters of Hays Run, in Rayburn township. It has been opened near the headwaters of Cowanshannock Creek east of Rural Valley, and has a reported thickness of 20 inches.

Bakerstown Coal. This bed lies about 160 feet above the Upper Freeport coal. Its outcrop has been noticed at many places in the county, but it will not average over 20 inches thick. It is reported to be locally 4 feet thick on Crooked Creek. It has never been mined.

Pittsburgh Coal. This bed lies about 650 feet above the Upper Freeport coal. Its occurrence is restricted to the highland on the southeastern border of the county in Kiskiminitas and South Bend townships, and is part of the most northern area of Pittsburgh coal in the State. The coal is slaty in some places and has many partings; in others it is clean and almost unbroken. It ranges from 6 to 10 feet in thickness, including its partings and roof coal. The roof coal is impure and is not mined. The lower division of the bed averages 7 feet thick, but the coal is pyritous and slaty. The impurities increase to the southwest. The coal is hard, mines out in cubical blocks, and stands transportation better than the soft Freeport coals. At Hicksville the lower division is 6 feet 10 inches thick, including a 2 inch shale parting; 2 feet 6 inches from the bottom. On Long Run it is 8 feet thick, but carries three thick shale partings. On Big Run it is 8 feet thick, including a 12 inch shale parting 5 feet from the bottom. On the headwaters of Harper Run the lower division is 8 feet 10 inches thick, including a 6 inch shale parting 2 feet 4 inches from the bottom. The coal has numerous small "knife blades" of pyrite scattered through it. The coal belongs to the high volatile class. Its volatile matter averages 33.5 per cent; its fixed carbon 56 per cent; ash 9 per cent; and sulphur 3 per cent.

Redstone Coal. The Redstone coal underlies a small area in the eastern part of South Bend and Kiskiminitas townships. It is about 40 feet above the Pittsburgh coal. The bed averages 15 inches thick, is very lenticular, and has not been mined anywhere in the county.

Sewickley Coal. The Sewickley coal is present only in the highest hilltops in eastern South Bend and Kiskiminitas townships. It lies 120 feet above the Pittsburgh, and varies from 12 inches to 5 feet thick, averaging less than 3 feet. The bed is much parted by bone and shale, making mining unprofitable.

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